Plant uses and storage in the 5th century BC Etruscan quarter of the city of Lattara, France

NATÀLIA ALONSO[1], NÚRIA ROVIRA[2]

[1] *Grup d'Investigació Prehistòrica, Departament d'Història, Universitat de Lleida, Pl. Víctor Siurana, 1, 25430 Lleida, Catalonia, Spain, e-mail: nalonso@historia.udl.cat*

[2] *ASM, Archéologie des Sociétés Méditerranéennes, UMR5140, Univ Paul-Valéry Montpellier, CNRS, MCC, 34000 Montpellier, France, e-mail: nuria.rovira-buendia@univ-montp3.fr*

Abstract An area between land and water was chosen in the 7th century BC by native Gauls and foreign Etruscan and Greek merchants to establish a commercial enclave. Then, in the early 5th century BC, this initial settlement at La Cougourlude with post-built houses on the banks of the small coastal river Lironde was relocated to the margins of a nearby lagoon along the Mediterranean coast, giving rise to the walled port city of Lattara. Archaeological excavations undertaken in the 2000s along the southern wall of Lattara in Quarter 27 revealed three houses which contained almost exclusively Etruscan pottery. The objective of this study is to analyse the archaeobotanical remains from these dwellings so as to identify the plant foods which were consumed and used by their inhabitants, as well as the methods of storage. The question arises whether anything particularly relating to Etruscan origins can be detected from the diet of the inhabitants. To study this aspect we have compared the data collected during the excavation with research undertaken at neighbouring settlements dating from periods either older, contemporary with or younger than Lattara, as well as research undertaken at sites in the Etruscan area of Italy.

Keywords *Plant uses · Storage · Etruscans · Iron Age · Southern France · Archaeobotany*

Introduction

Lattara was a port city founded around 500 BC (Lebeaupin and Séjalon 2014, p 323; Daveau and Py 2015) in southern France at Lattes, Hérault, with a history spanning more than seven centuries (Py 2009). It was established directly along the *stagnum latera* lagoon, today the étang du Méjean, between the two branches of the river Lez. This fluvial-lagoon environment characterised by both fresh and salt water, as well as wet and dry land, dictated the types of fauna and flora the city exploited throughout its history (Fig. 1).

Before the foundation of Lattara at the beginning of the 5th century BC, the area had already been occupied since the Final Bronze Age and during the First Iron Age, as shown by the sites of La Cougourlude (Daveau and Py 2015), Port Ariane (Daveau 2008) and Mas de Causse

(Newman and Silveréano 2010; Daveau and Py 2015). The 7th-6th century levels of these sites, especially those of La Cougourlude, reveal the importance of exchanges with first Etruscan and then Greek traders in particular, through the abundance of pottery. Ditches surrounded the village and semi underground huts were built of wooden posts and wattle and daub; pits and hearths were also found. Around 475 BC the residents of La Cougourlude progressively abandoned the village for the nearby fortified city of Lattara. Mediterranean merchants, Etruscans, Greeks, possibly even Iberians and local groups of people would have founded this new city. Lattara was therefore, at the beginning of 5th century BC, the hub of a protected and regulated place of exchange where Etruscan traders seem to have occupied a privileged position. The function of this commercial enclave, most probably under the authority of the *Sextantio Oppidum*, at Castelnau-le-Lez, 7 km to the north-east, seems to have been to open or expand a bridge between the Mediterranean sea and the inland hinterland (Daveau and Py 2015, p 33). The extent of the hinterland of Lattara, however, is little known and has yet to be confirmed by research (Lebeaupin and Séjalon 2014, p 321-329).

Archaeological excavations in an area of the rampart, near the city's south gate leading to the harbour (at least in the 4th-3rd centuries BC), brought to light three houses dating to the early phases of the fortified settlement (Quarter 27). There were several indicators suggesting that Etruscans inhabited these houses. In fact, everything about these houses differed from the traditional regional dwellings. The building types, for example, were innovative, revealing a complex and uniform architecture. Likewise, in this sector the pottery was almost exclusively Etruscan, often bearing inscriptions (Py 2009, p 39-53; Lebeaupin and Séjalon 2014).

The construction and furnishings of these houses suggested that they were designed to last. However, they had only stood for a few months or years when, toward 475 BC, they were destroyed by a great fire. Although there is no indication of how the fire began and why, it was probably a deliberate and general event, because contemporary levels of Quarter 1, situated in the north-east of the city, also show signs of destruction by fire (unpublished data from 2015 excavations). Furthermore, the archaeological record reveals a dominance of local elements from this moment, and throughout the rest of the 5th century, as well as a decline or “disappearance” of Etruscans in favour of Greeks from Marseilles (Py 2009, p 69; Lebeaupin and Séjalon 2014, pp 326-328).

This article therefore aims to characterise the use of plant products by these Etruscan residents based on the analyses of seeds and fruits collected during the archaeological work. Although this study only represents a snapshot of the brief Etruscan occupation, we do consider it

interesting, especially due to the unique foreign quality of both the features and the residents. In addition, to date, few Etruscan contexts have been examined from the archaeobotanical viewpoint. It is also interesting to compare these results with those of the subsequent periods, when Lattara tended toward an indigenous character with Greek and later Roman influences.

Materials and methods

Sampling and archaeobotanical analyses of fruit and seeds have been undertaken systematically at Lattara for the last 30 years. Most of these analyses are published either in the Lattara series (Buxó 1989, 1991, 1992, 1996a, 1999, 2003, 2005; Py 1997; Alonso and Rovira 2010, 2014) or in scientific journals (Buxó 1996b, 1997; Py 1993; Py and Buxó 2001; Alonso et al. 2008). Data regarding the immediate surroundings of the ancient city both before and contemporary with its occupations were obtained from the studies of the neighbouring sites of Port Ariane (Alonso et al. 2007, 2011), Mas de Causse (Rovira 2010) and La Cougourlude (Figueiral and Bouby 2014).

Sampling strategies were based on test samples of 20 l of sediment, which were used to evaluate the presence and richness of bioarchaeological remains such as seeds and fruits, charcoal, fish bones etc and to calculate thereafter the volume of the total sample and the remains recovered by water-sieving techniques using flotation or other methods. Systematic sampling concentrated upon both plant treatment activities such as storage, culinary preparation etc. and on waste management features such as hearths, containers, silos, other pits, areas such as houses, courtyards, streets etc. and all sorts of fills containing organic matter. At present there are around 3,400 samples available, representing 73,340 l of sieved sediments from the total occupation levels which were excavated on the settlement and dated from the 5th century BC to the 2nd century AD.

Although the number of samples containing seed and fruit remains from Etruscan contexts in Quarter 27 is not very high, a total of 28, most of the excavated areas are represented. The majority of the samples (21) were collected from the level of fire destruction (27I2) (ESM Table 1), whereas only a few are associated with the abandonment level (ESM Table 2).

The stratigraphic units (SU) comprise layers of fire destruction remains of features constructed with earth or perishable materials, or deposits associated with the contents of amphorae. Some floor levels were also sampled. Most samples from the destruction phase were collected in groups where there was a concentration of organic matter such as charcoal, ash, seed and fruit remains etc., and these were differentiated according to the stratigraphic units (SU) and collected or sampled separately from other sediments the unit (8 samples),

while a few of these units were collected either in a dispersed or isolated manner (4 samples respectively) (ESM Table 1). In contrast, most of the samples associated with the abandonment phase were dispersed (5 samples). Only one was collected as a group and one isolated (ESM Table 2).

The samples correspond, for the most part, to concentrations of cereals found in crushed amphorae, especially in House 2713. Most archaeobotanical elements associated with the other two houses (2714 and 2715) were scattered in the different destruction layers. Certain small concentrations have, nonetheless, been found. A concentration is defined by the presence of more than 1,000 individuals, representing about 80% of the sample individuals in the sample. These individuals can consist either of whole or fragmented remains that retain a unique morphological feature permitting their identification - for cereals caryopses, the area of the embryo (Jones 1990); for grape pips, the beak; for pulses and fruits, the number of whole cotyledons or the number of halves of endocarps of the same taxon in a single sample, divided by two.

The Index of Relative Abundance (IRA, % of individuals + % of ubiquity) is a second factor applied in this study (Hastorf et al. 2005). It is used to calibrate in a single figure the number of individuals. Finally, other units of measurement are the number of remains (NR) and the number of individuals (NI). These are relevant to the absolute quantification of the seed remains either per sample or per stratigraphic unit.

Results of the analyses of the remains from the different houses

Six samples from phase 27I2 were considered as concentrations:

- *Triticum aestivum/durum* (naked wheat): SU 28111 (83.7 %) and SU 28112 (79.4 %) in House 2713;
- *Hordeum vulgare* (hulled barley): SU 28166 (99.05 %) in House 2713, SU 27674 (94.4 %) in House 2714 and SU 27565 (92.2 %) in House 2715;
- *Juncus* sp. (rush) in the southern alley, a single layer [SU 27665] where rush seeds and capsules represent 99.6 % of those identified.

The volume of sediment sieved during the excavation was high when compared to that of other phases of the 5th century BC in this zone (Alonso and Rovira 2010). Of the 839.5 l of sieved sediment, 100,634 seed and fruit remains were collected, for the most part in the concentrations described above. For this reason, the density of the archaeobotanical remains is quite high, between 48.35/l in the southern alley and 394.98/l in House 2714. The

stratigraphic units with the highest densities also correspond to the concentrations in the destruction phase, with up to 1,655 remains/l in SU 27674, while the densest sample of the abandonment phase has 21/l. All of the archaeobotanical remains were preserved by charring. Overall, 16 cultivated plant and 28 wild plant taxa were identified.

Fire destruction level (Phase 27I2)

House 2713

Several positive samples were collected in Rooms 15 and 20 of House 2713. "Positive" means the sample contained more than 20 seed and fruit remains; negative - less than 20 remains, null - no remains. (Fig. 2; ESM Tables 1, 3). Room 20 was probably a vestibule. It contained two archaeobotanical assemblages. The first was a concentration of seeds inside the fragmented base of an Etruscan amphora. The second was a layer of ash on the floor of the room. This layer extended into the adjacent Room 15 over the threshold of the door.

The grain concentration consisted almost exclusively of *Hordeum vulgare* (NI=3,550, plus the fragments), representing 99.05 % of the individuals. The diversity of crops is therefore negligible. The other taxa in the assemblage were *Triticum aestivum/durum*, *T. dicoccum* (emmer) and a fragment of *Olea europaea* (olive). Wild plants (*Avena* sp., oats; *Lolium* sp., ryegrass, *L. temulentum,* darnel; *Plantago* sp., plantain) represent only 1 % of the total and were probably weeds associated with the cultivation of *Hordeum*. This assemblage represents grain stored in the amphora. In general, all these elements are indicative of domestic activities.

Room 15 was a storage area characterised for the most part by a large number of Etruscan amphorae, as well as pottery for both the kitchen and table. The western part of the room appears to have been used to store cereals and other food products, while the eastern part had mixed use. The centre of the room was practically devoid of archaeological material and consumption residues such as animal remains. It therefore does not give the impression of an occupied room. The samples comprised mainly charred grains associated directly with the bases of amphorae or amphorae crushed in situ. A sample was also taken from the fire destruction layer at floor level.

The results thus show that the grains stored in several amphorae in the room were mostly *Triticum aestivum/durum*. The proportions of this variety of wheat in the three concentrations [SU 28111, 28112, 28117] are respectively 83.7, 79.4 and 86.5 % of the total of individuals and 98.9, 86.69 and 95.5 % of the total number of individuals in crop plants. Regarding the

latter, the diversity of these samples is, once again, very low. The taxa that accompanied *T. aestivum/durum* were *Hordeum vulgare* (hulled), *T. dicoccum*, undetermined pulse, *Olea* and *Vitis vinifera* (grape). These last three were only represented by one individual each. A few remains of emmer chaff, spikelet bases and glumes were also identified. These were probably contaminants in the stored *T. aestivum/durum*, however, no naked wheat chaff was observed.

A total of 14 wild, probably weed taxa were identified. The best represented weeds are those associated with winter cereals, especially when they are compared with the large number of *Lolium* sp., followed by Poaceae, *Phalaris* sp. (canary grass), *Avena fatua* (wild oat), *Agrostemma githago* (corn-cockle), *Anthemis cotula* (stinking chamomile), *Galium* sp. (bedstraw), *Silene vulgaris* (bladder campion) and *Asperula* sp. (woodruff). Furthermore, the scarce presence of *Malva sylvestris* (common mallow), *Bromus* sp. (brome grasses), *Polygonum aviculare* (knotgrass) and *Rumex* sp. (docks) among the ruderal or spring weeds is noteworthy. Finally, a few *Juncus* capsules, characteristic of wetlands, were also identified. The significant amount of weed seeds in the stored *Triticum* suggests that the wheat was not properly cleaned and thus not yet fit for consumption. Sorting out these contaminants would have been necessary before preparation as food.

Stratigraphic unit 28117 also contained five seeds of *Linum* sp. (linseed) that could not be identified as *Linum usitatissimum* (domesticated flax), a taxon which was found, however, in the current destruction phase in the same house (ESM Table 4, SU 28150). This plant, the fibres of which were used for textiles and the seeds for oil and as food, has been recorded in other contexts from the 5th century BC (Alonso and Rovira 2010).

In sum, the archaeological remains from Room 15 serve as evidence of the storage of *Triticum aestivum/durum*. Only one amphora appears not to have served as a cereal container [SU 28095]. In addition, the results obtained from the sampling of the sediment around the amphora and in the rest of the room do not reveal any evidence that might contradict this observation, because no evidence of waste related to consumption such as animal remains, for instance, has been found.

House 2714

Sampling in House 2714 took place in the two northern rooms (1E and 1F), although unfortunately these were not totally excavated (Fig. 2; ESM Tables 1, 5). These rooms were domestic spaces that indicated many activities. The large room to the south (1B) is interpreted as a storage space, as in the case in the previous house.

A single sample with very few remains was taken from Room 1F, a vestibule in which there were few plant handling activities. Room 1E is interpreted as a kitchen. Samples gathered from its floor level [SU 27589] and other floor level concentrations with charcoal and ash [SU 28074], yielded plant remains. Both assemblages bear similar elements that show that this room differed from others, as the taxon best represented there is *Setaria italica* (Italian millet) accompanied by remains of *Bolboschoenus maritimus* (sea club-rush).

Two other samples appear to reflect the same type of varied activity. This is shown by the presence of 11 taxa. It is also noteworthy that the highest diversity of crop plants occurred here, despite the modest number of remains. *Setaria italica* was accompanied by some *Hordeum vulgare* and *Triticum aestivum/durum* caryopses, an olive stone and a mineralised grape seed. The seeds of wild plants indicate the occasional presence of *Galium*, *Lolium*, *Medicago* sp. (medick), Poaceae, Cyperaceae and Chenopodiaceae.

The relatively large amount of *S. italica* is not surprising in itself, given the large number of caryopses in each panicle. What is more interesting is its occurrence in combination with numerous seeds of *Cyperus* (galingale) or *Bolboschoenus maritimus*. There are two possible interpretations for the occurrence. Firstly, *B. maritimus* could have been a companion weed to *S. italica* cultivated in damp conditions. Today, for example, this weed is characteristic of Camargue rice fields (Audebert et al. 2013). On the other hand, its presence could be linked to the consumption of its roots and tubers (Wollstonecroft et al. 2008), or the use of its stalks for wickerwork or construction materials such as for roofing, as mentioned above (Claret de la Tourrette 1796, p 168). The fact that no other plant parts except seeds were found with the *S. italica* allows us to tend towards the first hypothesis.

In the case of Room 1B, three of the four samples analysed in this sector, including two from sandy soils and the remains of the destruction of an unidentified earthen feature, show a minimal density between 0.1 and 12remains/l. This indicates, as its “twin” in House 2713, that domestic activity is this space was very limited. A single concentration of *Hordeum vulgare* was found in the northwestern corner of Room 1B [SU 27674] perhaps corresponding to grains stored in an undetermined wooden box or placed on a wooden shelf (Fig. 2; ESM Table 5; Cammas 2014, p 100). The concentration comprised 66,200 remains, including 41,029 individuals and 22,504 fragments of *Hordeum* representing 95.97 % of the concentration. Although four other cultivated taxa were present in the concentration, *Triticum aestivum/durum*, *T. dicoccum*, *Lens culinaris* (lentil) and *Pisum sativum* (pea), only the first is represented by a somewhat larger quantity (NR=168).

Wild plants are well represented by 14 taxa and a fairly large number of remains. Weeds of winter cereals are predominant, especially Poaceae, including a large number of undetermined caryopses and many seeds and glumes of *Avena* sp., followed by *Lolium temulentum* and *Bromus sterilis* (sterile brome). *Silene* sp. and *Anthemis cotula* were also quite abundant, while *Papaver dubium/rhoeas* (poppy) and *Phalaris* were occasional. Of note among the ruderal plants are *Rumex*, *Malva sylvestris* and *M. nicaeensis* (mallows), *Carex hirta/distans* (sedges), *Chenopodium album* (goosefoot) and *Rosmarinus officinalis* (rosemary). Also noteworthy are chaff remains of several taxa, especially *Triticum* spikelet bases and glumes, several rachis segments of *Hordeum*, and glume bases and awns of *Avena fatua*. This assemblage could correspond to a biocoenosis (the original combination of a growing plant community) because a) it was deposited in a container, b) there was almost no sediment among the seeds and c) the density of the remains was very high, with 1,655 remains/l sieved from 40 l of sediment. In this case, these plants would have grown together in the same field, rendering the conclusions about the environment much more relevant.

A final observation is that the amphorae stored in this room were devoid of plant remains, unlike those of House 2713. They therefore must have contained other products, possibly wine or oil.

House 2715

House 2715 was only partially excavated. Its features consisted of two rooms connected by a door. Archaeobotanical sampling was therefore restricted to one of the two rooms (1A) (Fig. 2; ESM Tables 1, 6). An isolated sample comprising 13 cloves of *Allium sativum* (garlic) was collected by hand from a sandy level [SU 27541] in Room 1D (Fig. 3.9). Because of limited excavation in this area, there is no information regarding the find's archaeological context. It is noteworthy, nonetheless, that *A. sativum* is unique at the site and this is the second oldest occurrence in France after that from Coudouneu, Provence, also dated to the 5th century BC (Marinval 1996-97). Furthermore, cultivated garlic is only known to have become widespread in western Europe in the 1st century BC, as shown in France, at Entrains-sur-Nohain (Wiethold 2009) and Oedenburg (Vandorpe and Jacomet 2011), or in the United Kingdom at Beverley (McKenna 1992).

The other samples from this house were collected from the destruction layer of an earthen feature and from a small isolated concentration near the door leading to the southern alley. *Hordeum* in both cases was the most abundant taxon. A few caryopses of *T. aestivum/durum*,

a single one of emmer, a number of legume seeds and a few weeds, Poaceae, *Lolium* and Rubiaceae, complete the sample.

The sample with the greatest concentration of *Hordeum* (92.2 %) also contained the highest diversity of crop plants for the entire room. Along with *Hordeum* were *Lens*, *Pisum*, *Vicia faba* (broad bean), *Vicia* sp. (vetch), *Vicia/Lathyrus* (vetch/grass pea), undetermined pulses and *Vitis*. However, since the excavated area was small, it is not possible to offer a precise interpretation of these seed assemblages. We do not know, for example, if they correspond to other activities related to storage or consumption.

Southern alley

Archaeobotanical data obtained from the excavated areas of the southern alley differ very much from those obtained in the dwellings (Fig. 4; ESM Tables 1, 7). This alley, which ran between the houses and the rampart, was only accessible from House 2715.

Almost all of the seed and fruit assemblages from the western sector of the alley [SU 27665] are characterised by a large amount of capsules (NR=6,857) and seeds (NR=3,625) of *Juncus* accompanied by stems of *Phragmites australis* (common reed) (Fig. 5,1-3). These plants were initially interpreted during the excavation as roofing material. Careful analysis, however, refutes this idea because of their orderly position (Meyer et al. 2014, p 48). They might, in fact, be the remains of either matting placed on the floor of the alley or sheaves or bundles which were scattered during the fire. The spread of *Phragmites* remains in the western part of the alley reveals that most seeds and capsules were concentrated to the south in sample areas 7, 3 and 1, near the wall, whereas to the north, in squares 8, 6 and 4, there were fewer remains (Fig. 4). The charcoal analyses did not identify *Juncus* stems (Chabal 2014). However, given the fragility of these plant parts because of their herbaceous structures free of lignin, it is possible that they were totally fragmented, or that they disappeared completely in the fire. In any case, the specific spread of these remains in the alley is noteworthy. Could it be indicative of an ordered arrangement of bundles of *Juncus*, mixed with *Phragmites* with their heads facing south? Or does this spread simply represent the storage of *Juncus* leaning against the rampart? In the latter case, *Phragmites* and *Juncus* were not mixed, but were two separate products destined for different purposes. The possibility that *Phragmites* was stored in the alley for other uses will be addressed in the discussion of the results.

Another remarkable fact is the increase in the variety of taxa and decrease in *Juncus* in the northwest corner in square 2. While *Phragmites* remains can be excluded as they were either part of mudbrick preparation or stored there for a particular purpose, and despite the low

number of remains (NR=161), the proportions of cultivated crops and wild plants are about 50 % each. The taxonomic diversity among the first is quite high. Hulled barley and naked wheat are the predominant species, followed by one or two remains of *Setaria italica*, *Vicia/Lathyrus*, *Olea*, *Prunus dulcis* (almond) and a few *Vitis* pips.

Wild plants, for the most part, are poorly represented. Here they are once again associated with self-propagating weeds of winter cereals, ruderals and spring weeds. *Bolboschoenus maritimus* stands out in the first group (Fig. 5.13). There are also undetermined Poaceae, as well as *Galium aparine* (cleavers), *Phalaris*, *Lolium*, *Avena fatua*, *Asperula* and *Bromus secalinus* (rye brome). Noteworthy in the last two groups is the presence of *Sisymbrium* sp. (rocket), *Carex* sp., *Medicago*, *Melilotus* sp. (melilot), *Amaranthus* sp. (amaranth), *Atriplex* sp. (orache) and *Malva*. Most of these wild plant seeds were collected in square 2 (east and west) of Stratigraphic Unit 27665 and would have accompanied the identified cereals. The remains from this square could represent the disposal of consumer waste in the alley.

The samples from the easternmost area of the alley are highlighted, in particular by fruit, notably *Ficus carica* (fig) and *Vitis*. The presence of *Bolboschoenus maritimus* fruits is indicative, once again, of the potential economic significance of this plant. Some of the caryopses of hulled barley, naked wheat, *Lolium* and Poaceae complete this assemblage, which is marked by a very low density of remains (2.13/l). Its interpretation as general consumer waste is the most plausible.

Phase 27I1

Phase 27I1 is characterised mainly by levels of destruction and backfill. Here, generally fewer samples were collected, thus resulting in less archaeobotanical data. The majority were collected randomly, with the exception of those from two layers of House 2715. The density of the plant remains there was very low. The highest corresponded to 21/l, a small assemblage of emmer and the average was 1.11/l (ESM Tables 2, 4). Archaeobotanical interpretations of this phase are therefore insecure.

House 2713

Differences between the rooms of House 2713 were not observed. All the samples were collected from backfills, heterogeneous levels of destruction and structures built with mudbrick. Only in one case [SU 28139] did the number of the remains reach 50, although most were fragments. *Hordeum vulgare*, *Triticum aestivum/durum* and *T. dicoccum* were present, as was *Panicum miliaceum* (broomcorn millet), *Linum* and *Vitis*. The number and the

diversity of the wild plant remains are also very low. Noteworthy is the presence of undetermined Poaceae, *Lolium*, Cyperaceae, Apiaceae, *Malva* and *Cistus* sp. (rock rose).

House 2715

The archaeobotanical remains from this house, in contrast to those from House 2713, are associated in part with an accidental deposit of charred seeds and fibres under a collapsed wall [SU 27491] and in part with a small concentration of bio-archaeological remains, notably fish scales [SU 27560]. The first assemblage is practically monospecific (NR=47) with *Triticum dicoccum* caryopses and some fragments of undetermined *Triticum*, one *Lathyrus sativus* and a number of wild Poaceae and *Lolium* sp. It is difficult to establish whether this small assemblage formed part of a larger *T. dicoccum* concentration stored in a wicker basket hung on the wall or placed on a shelf. The second sample consisted predominantly of cereal grains, *H. vulgare*, *T. aestivum/durum* and *T. dicoccum*.

Discussion

The archaeobotanical remains recovered in the Etruscan dwellings comprise, for the most part, cereals, pulses and fruit. Certain assemblages were accompanied by a large number of wild plant seeds, essentially weeds of winter cereals and ruderals (ESM Tables 3-7). The abundance of *Juncus* seeds and capsules in the southern alley associated with *Phragmites* stems is also noteworthy. The main activities identified with these plants are storage and, in certain cases, consumption.

Cereal storage and processing

The first conclusion that emerges from the study of the different archaeobotanical assemblages retrieved from the Etruscan houses of Lattara is the prevalence of grains, in particular hulled *H. vulgare* and *T. aestivum/durum*, over other crops known to have been cultivated in the 5th century BC (Table 1; Alonso and Rovira 2010). These assemblages also reveal a system of storage mainly in amphorae, but possibly also in other containers made of wood, such as chests, or wicker, as in bags or baskets, such as some charred fragments of the latter, of a woody undetermined monocotyledon found in Room 1F of House 2714 (Chabal 2014, p 151). In fact, the use of amphorae to store grain was only found in House 2713. This is the case of *T. aestivum/durum* in the storage area of Room 15 and hulled *H. vulgare* in Room 20. Additional amphorae stored in these rooms could have contained other products, such as wine (McGovern et al. 2013, 2014).

The warehouse of House 2714 was equipped with another storage system. *Hordeum* was stored here in a wooden chest. Finally, the use of a basket or a bag hanging on the wall, or placed on a shelf, was suggested to explain the presence of a small *T. dicoccum* assemblage trapped under a collapsed wall of House 2715. The storage of these types of foodstuffs seems confined to the domestic realm. Although we cannot determine the original quantities, we suppose that they were not very high. These assemblages also reflect a wide variety of stored plant products.

The reasons for the predominance of *T. aestivum/durum* in House 2713 and *H. vulgare* in Houses 2714 and 2715, although in smaller quantity and with fewer food containers, are difficult to discern. Did the residents of these houses have more time than their neighbours from House 2713 to salvage goods before the fire? In any case, based solely on the present data which are restricted in space and time, we cannot draw general conclusions about the existence of foodstuff traditions or specific dietary tendencies. Nevertheless, it is remarkable that *H. vulgare* has an Index of Relative Abundance greater than 150 in all the houses, whereas *T. aestivum/durum* and *T. dicoccum* only have a high IRA in House 2713 (Fig. 6). Although *T. aestivum/durum* and *H. vulgare* in the southern alley display the same index, both the number of the samples, as well as the remains, are too meagre to draw conclusions. Do these results ultimately reflect the variety of food choices among the residents of this quarter? Or are they simply a snapshot as a consequence of random preservation of the archaeobotanical remains after the houses were engulfed in fire?

What seems certain in almost all of these cases is that grains were stored clean, almost completely processed and prepared for cooking. They only required a final manual cleaning, as in the case of the barley concentration of House 2714, an assemblage that had the largest numbers of chaff fragments and grains of weeds, even if their percentages are very low compared to those of the proportion of the grain (grain = 96.08 %; chaff = 0.74 %; weed seeds = 3.18 %). In all of these concentrations, the percentages of weeds compared to those of cereal grains reach a maximum of 6.6 %, whereas among weeds the larger seeds attain a maximum of 17 %. This indicates that all stages of the agricultural operational sequence following the harvest were completed and conducted elsewhere, with the exception, as we have pointed out, of the final manual cleaning that must be carried out before food preparation. The question also arises as to the form of the last phase of cereal processing. It is of note that no querns were found in the Etruscan houses. But since the area occupied by these houses was not totally excavated, it is possible that specific outdoor or indoor spaces assigned

to cereal milling were not identified. However, a few hearths have been found, as well as Etruscan tableware pottery (Lebeaupin 2014).

In spite of the impression of abundance offered by the charred grains in the houses, the quantity recovered, in fact, corresponds to a modest amount of stored plant products. A first option is that the residents may have had time to salvage some of the grain before the fire. A second option is that the grain reserves were not copious at that moment in time. We know that Etruscan amphorae were used for storing grain. Some of these containers were actually re-used for grain storage, because chemical analysis of their residues shows that they had previously held wine (McGovern et al. 2014).

Finally, it is noteworthy that only one other cereal, *Setaria italica*, was identified in the form of a small concentration in Room 1E of House 2714. In this case, the scattered remains do not reflect a stored commodity, but are residues of consumption or waste. This is also the case with other mixed assemblages comprising cereals, pulses, fruits and agricultural by-products.

The diverse taxa of wild plants that accompany the cereal concentrations mainly reflect autumn-sown crops. Indeed, these winter weeds are among the largest vegetation group according to both the number of remains and Index of Relative Abundance (Fig. 7a). Ruderal plants and spring weeds are much less abundant and less diverse. Each concentration of wheat or barley presents no major differences, as 71 % - 100 % of the wild taxa can be associated with weeds of winter cereals. Only three samples show a high percentage of weeds linked with spring-sown crops, whereas three samples seem to show evidence of ruderals (Fig. 7b). All these wild plants reflect open environments affected by human activities. The absence of plants associated with wetlands except for *Phragmites* and *Bolboschoenus maritimus*, which were more abundant in more recent chronological phases (Alonso and Rovira 2010; Rovira and Alonso 2010), offers indirect information as to the location of the fields, mainly in dry environments, except for the *S. italica*. All these wild plants are endemic in the natural environments surrounding Lattara, so grain does not appear to have been imported from the Etruscan area of Italy. However, we cannot be definitively sure, because we actually do not know the place of origin and thus the environment of these traders.

Remains of edible pulses, fruit and other taxa

Pulses are represented for the most part by four taxa: *Lens*, *Pisum*, *Lathyrus* and *Vicia* and a few other specimens which proved difficult to identify due to their low numbers. It is noteworthy that their Index of Relative Abundance is higher than *T. dicoccum* or any fruit,

especially in House 2715. They are well represented in House 2715, as well as throughout the Etruscan quarter, and seem to correspond more to food waste than stored products.

Fruit remains are a minority and have a fairly low IRA (34 at most). Only *Vitis* appeared in the three houses along the alley, while other taxa were distributed more randomly. These include olives in Houses 2713 and 2714, as well as in the southern alley. Figs and almonds were also present in the southern alley and *Prunus* sp. (possibly a plum) was only found in House 2713. These assemblages are also interpreted as dispersed remnants of consumption.

The very limited presence of *Vitis* remains, always in the form of grape pips, does not provide specific information as to the role of local viticulture or if the grapes were destined for the table or the vat. The import of wine can be inferred by the many Etruscan wine amphorae in these houses (McGovern et al. 2013, 2014). The slight presence of grapes, in contrast to that of subsequent periods, might indicate that there was little viticulture. However, the evidence of these early phases of occupation at Lattara is too limited to formulate hypotheses, especially regarding the early state of viticulture. A similar situation can be applied to other fruit. What was the real condition of olives, figs and almonds during this early phase of Lattara? Were they imports, in brine in the case of olives and dried in all the cases, or grown locally?

The question regarding olive cultivation at Lattara has been the object of a number of studies (Puertas 1998; Py 2009; Alonso and Rovira 2010). The absence of *Olea* pollen around the site, as well as the absence of *Olea* charcoal as fuel for the city's domestic fireplaces in all chronological periods, is a strong argument to dismiss the idea of local olive cultivation. Moreover, in the Etruscan contexts, there were only two objects carved from *Olea* wood (Chabal 2014) leaving open the option that they had been made elsewhere.

Ficus carica and *Prunus dulcis* are not present in palynological data (Puertas 1998). So far, from charcoal and wood remains, only the fig tree is known to have been present at the site. It is nonetheless only found in small quantities around 375 BC (Chabal 2005, 2014). All the olives, figs and almonds in Lattara were almost exclusively in the form of fruit remains, indicating consumption. Their remains cannot in any case be taken as evidence that these trees grew in the urban context. Their origin, therefore, has to be sought either in the surroundings of Lattara or as long-distance imports.

Finally, the first find of garlic at Lattara is significant. This served as a food condiment and a medicinal plant. All species of the genus *Allium* contain sulphur compounds derived from allyl sulphites that have medicinal properties (Block 1985).

The use of *Juncus* and *Phragmites*

The presence of reed bundles in the southern alley of the Etruscan quarter was first interpreted as matting for sanitation purposes. It has been shown that these were not bundles of reeds that fell from the roof during the fire and ended up in a horizontal position on the ground (Meyer et al. 2014). Another option is that they were stacked vertically against a wall that slipped to the ground. In any case, archaeobotanical analyses indicate *Juncus* among the reeds, in spite of the fact that their stems were not preserved after the fire. It has also been hypothesised that the *Juncus* bundles, not mixed with *Phragmites*, were in storage, ready for some other uses.

In antiquity, many *Juncus* species were used for lighting. The stems were soaked in animal or vegetable fat and left to harden to form sorts of candles. Pliny the Elder lists different types of utilitarian objects made with reeds in his *Natural History*, Books 21, 69 (Zehnacker 1999). These included wicker baskets, fish traps, mats made of interlaced wisps of straw and rush and cords to make ties for construction, vine working and wells. Several plants are grouped under the common name "rushes", including those that belong specifically to the genus *Juncus*, as well as others belonging to the Cyperaceae family (sea club-rush or galingale, for example). In all cases, the production technique is identical. These flexible but robust stem-leaves could be used to weave objects, including mats and carpets.

Due to the absence of stem-leaves, it is difficult to comment on the possibility that they were woven. It also seems unlikely that they were used as ties to fasten bundles of reeds since the seeds and capsules were dispersed, not concentrated in one area. We therefore suggest that the reeds were being stored, rather than having been finished materials. It is also possible, however, that the locals used these different materials simply as a crude method of covering the ground when moist.

Conclusions

From the results obtained from the seed analyses, the diet of the inhabitants of the Etruscan houses of Lattara in the early 5th century BC was based on cereals such as hulled *Hordeum vulgare*, *Triticum aestivum/durum*, *T. dicoccum* and *Setaria italica* and at times certain pulses such as *Lens*, *Pisum*, *Lathyrus* and *Vicia*, fruit including grapes, olives, figs, almonds and possibly plums and other items such as garlic.

There is little archaeobotanical data available from Etruscan sites in Italy to compare with those from Lattara. In fact, except for a few cases, research on the Etruscans to date has focused primarily on cultural and artistic aspects, as well as information from old written

sources. Very few excavations to date of Etruscan sites have benefited from systematic archaeobotanical sampling (Mercuri et al. 2015) and in the cases where sampling was carried out, the sediments were not favourable for analysis (Malone et al. 2014, p 259).

An exception is the settlement of Gran Carro, on the eastern bank of Lago Bolsena (Costantini and Costantini-Biasini 1987). This site, dating from the earlier Villanovan Culture in the 9th century BC, included mostly grape pips, *Cornus mas* (cornelian cherry) and *Prunus spinosa* (sloe). Also identified were remains of *Triticum dicoccum*, *Vicia faba*, *Corylus avellana* (hazel) and *Prunus insititia* (bullace). Another exception is the site of Podere Tatuchino with an occupation from the late 6th to the late 4th century BC (Perkins and Attolini 1992). The main archaeobotanical remains here belong to Phase II in the first half of the 5th century BC, contemporary with the Etruscan quarter of Lattara. These remains are characterised by *Vitis* pips, *T. dicoccum* (in the form of chaff) and *Olea* fruitstones, together with a large quantity of weed seeds (Perkins and Attolini 1992, pp 108-109, 126-130).

Archaeological work at Tarquinia has provided information on ritual deposits from the 6th century BC and identified various cereals, *Hordeum vulgare, T. aestivum/durum, T. dicoccum, T. monococcum* and *T. spelta*, the pulses *Lens culinaris* and *Vicia/Lathyrus*, cultivated fruit *Ficus carica* and *Vitis vinifera*, gathered wild fruit *Sambucus*, and *Papaver somniferum* (Bonghi Jovino 2010, pp. 172-173). At Blera in the 4th-3rd centuries BC, in the rural hinterland of Tarquinia, a sample recovered from a Hellenistic well revealed mostly grape pips, as well as small quantities of *Hordeum*, *Olea*, *Ficus*, *Cornus mas*, *Corylus* and *Quercus* sp. (acorns) (Costantini and Giorgi 1987). More recently, a preliminary archaeobotanical study at the settlement of Col di Marzo, Perugia, revealed the dominance of *Triticum*, probably *T. aestivum/durum* and *Vitis* in a late Etruscan phase (4th-3rd century BC). Other grains at this site such as *Hordeum* and *Setaria italica*, as well as *Olea*, *Pisum*, *Lens* and *Vicia faba*, are secondary (Malone et al. 2014, pp 261-262).

The diversity of the cultivated plants at the Etruscan sites is equivalent to that of Lattara, with the exception of *Papaver somniferum*. Furthermore, this wide spectrum of plant products is also known elsewhere in the south of France from at least the early Iron Age and possibly even earlier (Marinval 1988; Ruas and Marinval 1991; Buxó 1997; Bouby 2014). In the surroundings of Lattara, all the different cereals, as well as *Lens*, *Vitis* and wild *Olea*, were found at the nearby site of Port Ariane in levels dating to the 7th century BC (Alonso et al. 2007, pp 236-240). Regarding *Vitis*, we note the presence in these old levels of occupation of pips of which the majority are morphologically similar to the wild form, together with

cultivated forms, evidence of the early phases of the development of local viticulture (Bouby 2014).

All the cereals recorded in the Etruscan houses of Lattara, as well as *Vitis*, *Ficus* and *Prunus* sp., were also present at La Cougourlude (Figueiral and Bouby 2014). There is, nonetheless, no evidence from La Cougourlude of pulses or olives. Furthermore, the wild plants and the environment around La Cougourlude are also very similar to those of Quarter 27 at Lattara. This settlement, located 1 km to the northeast of Lattara, was founded in the 7th century BC by an indigenous population (Daveau and Py 2015). Throughout the 6th century BC, imports of Mediterranean pottery were very common. Originally, these imports were almost exclusively Etruscan, mainly amphorae, followed by Greek vases, notably from Marseilles. The abandonment of La Cougourlude in about 475 BC is associated with the foundation a few years earlier of the fortified city of Lattara.

Finally, the religious and domestic area of Mas de Causse, contemporary and associated with the settlement of La Cougourlude (Newman and Silveréano 2010; Daveau and Py 2015), shows a similar combination of plants. These comprise, for the most part, *Hordeum vulgare*, *Triticum aestivum/durum*, *T. dicoccum*, *Vicia faba*, *Pisum*, *Vitis* and *Ficus*. Notable is the absence of olives, as in the case of La Cougourlude (Rovira 2010).

The plants consumed by the inhabitants of the Etruscan quarter of Lattara were the same as those from subsequent levels, toward 475 BC, after the fire, when the quarter was redeveloped (Table 1; Alonso and Rovira 2010). The inhabitants, now under a growing Greek influence, carried on with an economy based on cereals, pulses and grapes. Cereals included mostly hulled *Hordeum vulgare* and *T. aestivum/durum*, as *T. dicoccum* tended to decrease and *Setaria* was sporadic. The most remarkable feature towards the end of the 5th century and throughout later periods is the development of viticulture and winemaking (Py and Buxó 2001; Alonso et al. 2008; Alonso and Rovira 2010; McGovern et al. 2013).

The seeds of wild plants identified in the concentrations of grains stored in the Etruscan houses do not seem to be examples of palaeobiocenoses (ancient living assemblages), as the crushed or burned state of the containers could have resulted in the mixture of their contents with those of other containers or with other plant remains in the soil. However, they appear to be evidence of the cultivation of most of these crops in fields with dry environments, which were probably near the city, nearby to the north or on a small plateau to the east. *Setaria italica* would have been the exception. If we take into account its association with *Bolboschoenus maritimus*, it could have grown in a wetter environment, perhaps near the lagoon along the Mediterranean coast. Of note is also the presence at Lattara of *Juncus*, a

plant that was not, theoretically, a foodstuff. It is conceivable that *Juncus* stem-leaves were used to cover floors and were also stored for other uses. Finally, we would also like to stress that the seeds of wild plants collected here do not provide evidence of having come from Etruscan parts of Italy, so the grain would not have been imported from there either; they are all characteristic of the local natural vegetation.

In conclusion, this work highlights the exploitation of plant resources in the ancient city of Lattara and its surroundings. It can be said that the inhabitants of the Etruscan quarter, having originally come either from the Etruscan area in Italy, Marseille or La Cougourlude, had what is considered a Mediterranean diet.

Acknowledgments This study was supported by the Labex ARCHIMEDE ("Investissement d'avenir" ANR-11-LABX-0032-01 program). Natàlia Alonso's participation was supported by projects HAR2012-36877 ("Production, Consumption and Power in Segre Valley and Northwestern Mediterranean between the 3rd and the 1st millennium BC", Ministerio de Economía y Competitividad, Spain) and SGR2014-273 (Generalitat de Catalunya, Catalonia). We wish to thank Stefanie Jacomet (University of Basel, Switzerland) for her help in identifying the garlic cloves, as well as Isabel Figueiral (INRAP, ISEM, France) and Laurent Bouby (CNRS, ISEM, France) for their unpublished data about La Cougourlude. We also thank Timothy Anderson for the translation into English and his remarks. Finally, we are grateful to the anonymous reviewers for their comments and suggestions to improve the article.

References

Alonso N, Rovira N (2010) Consommation et traitement des produits végétaux à Lattara entre -475 et -350. Lattara 21:329-388

Alonso N, Rovira N (2014) Stockage de céréales et consommation de végétaux divers attestés dans les maisons du quartier étrusque de Lattara (Lattes, Hérault) au début du V siècle av. n. è. Lattara 22:183-200

Alonso N, Buxó R, Rovira N (2007) Recherches sur l'alimentation végétale et l'agriculture du site de Port Ariane: étude des semences et fruits. Lattara 20:219-249

Alonso N, Buxó R, Rovira N (2008) Archéobotanique des semences et des fruits de Lattara: bilan des recherches. (Gallia 65) CNRS editions, Paris, pp 193-200

Alonso N, Buxó R, Rovira N (2011) Nouvelles données carpologiques pour la basse vallée du Lez (Sud-Montpelliérais, Hérault, Languedoc-Roussillon) du Néolithique moyen au Moyen Âge. Le site de Lattes-Port Ariane. In: Wiethold J (ed) Carpologia. Bibracte 20:101-118

Audebert A, Mouret JC, Roques S, Carrara A, Hammond R, Gaungoo A, Sanusan S, Marnotte P (2013) Colonization and infestation ability of *Bolboschoenus maritimus* Palla in rice paddies of the Camargue, France. Weed Biol Manage 13:70-78. http://dx.doi.org/10.1111/wbm.12012.

Block E (1985) The chemistry of garlic and onions. Sci Am 252:94-103

Bonghi Jovino M (2010) The Tarquinia project: a summary of 25 years of excavation. Am J Archaeol 114:161-180

Bouby L (2014) Agriculture dans le bassin du Rhône du Bronze final à l'Antiquité. Agrobiodiversité, économie, cultures. Archives d'Ecologie Préhistorique, Toulouse

Buxó R (1989) Semences et fruits: recherches sue les données carpologiques dans les niveaux antiques de Lattes, les procedures expérimentées sur la fouille. Lattara 2:73-82

Buxó R (1991) Echantillonnage et enregistrement des prélèvements. Lattara 4:101-106

Buxó R (1992) Cueillette et agriculture à Lattes: les ressources végétales d'après les semences et les fruits. Lattara 5:45-90

Buxó R (1996a) Encart A: les semences recueillies dans la maison en torchis. Lattara 9:360

Buxó R (1996b) Evidence for vines and ancient cultivation from an urban area, Lattes (Hérault), southern France. Antiquity 70:393-407

Buxó R (1997) Arqueología de las plantas. Crítica, Barcelona

Buxó R (1999) Première approche des plantes exploitées au IVe siècle avant notre ère à Lattes. Lattara 12:525-535

Buxó R (2003) Etude carpologique de la place 123: problématique de la presence de restes de semences et de fruits dans un espace urbain non construit. Lattara 16:193-217

Buxó R (2005) Etude carpologique des puits de Lattes: evaluation et comparaison avec l'habitat. Lattara 18:199-219

Cammas C (2014) Géoarchéologie des villes: nouvelles données micro-stratigraphiques sur la phase archaïque de Lattara (îlot 27). Lattara 22:93-114

Chabal L (2005) Charbons de bois et bois gorgé d'eau : des jardins de Lattara aux forêts du delta du Lez. Lattara 18:221-234

Chabal L (2014) Le bois dans l'architecture et le mobilier (500/475 av. notre ère); les boisements aux origines de Lattara. Lattara 22:115-166

Claret de la Tourrette MAL (1796) Démonstrations élémentaires de botanique, contenant les principes généraux de cette science, les fondements des méthodes, & les élémens de la physique des végétaux, la description des plantes les plus communes, etc., rangées suivant la méthode de Tournefort & celle de Linné. vol. 3, Bruyset Ainé & Cie, Lyon

Costantini L, Giorgi JA (1987) Blera. I resti vegetali. In: L'alimentazione nel mondo antico. (Gli Etruschi, Ministerio per i Beni Culturali e Ambientali 2) Ministerio per i Beni Culturali e Ambientali, Roma, pp 83-87

Costantini L, Costantini-Biasini L (1987) Bolsena-Gran Carro. I resti vegetali, In: L'alimentazione nel mondo antico. (Gli Etruschi, Ministerio per i Beni Culturali e Ambientali 2) Ministerio per i Beni Culturali e Ambientali, Roma, pp 61-67

Daveau I (ed) (2007) Port Ariane (Lattes, Hérault). Construction deltaïque et utilisation d'une zone humide lors des six derniers millénaires. (Lattara 20) Edition de l'Association pour le développement de l'archéologie en Languedoc-Roussillon, Lattes

Daveau I, Py M (2015) Grecs et Etrusques à Lattes: nouvelles données à partir des fouilles de la Cougourlude. In: Roure R (ed) Contacts et acculturations en Méditerranée occidentale. Hommages à Michel Bats. (Collection Etudes Massaliètes 12. Bibliothèque d'archéologie méditerranéenne et africaine 15), Errance Centre Camille Jullian, Maison méditerranéenne des sciences de l'homme, Aix-en-Provence Paris, pp 31-42

Figueiral I, Bouby L (2014) Les graines et les fruits de La Cougourlude (Lattes, Hérault): économie, environnement et alimentation au cours de la Protohistoire. In : Daveau I (dir) Lattes, La Cougourlude et Mas de Causse 2 (Languedoc-Roussillon, Hérault), Village du premier âge du Fer et zones funéraires romaines : Rapport final d'opération de fouille archéologique. Unpublished technical report submitted to the Inrap and the Regional Archaeological Service, vol 2, Nîmes-Montpellier, pp 307-324

Hastorf CA, Whitehead WT, Johannessen S (2005) Late prehistoric wood use in an Andean intermontane valley. Econ Bot 59:337-355

Jones G (1990) The application of present-day cereal processing studies to charred archaeobotanical remains. Circaea 6.2: 91-96

Jorda C, Chabal L, Blanchemanche P (2008) Lattara entre terres et eaux: paléogéographie et paléoboisements autour du port protohistorique de Lattes (Hérault). (Gallia 65) CNRS editions, Paris, pp 11-21

Lebeaupin D (ed) (2014) Les origines de Lattara et la présence étrusque. Les données de la zone 27. (Lattara 22) Edition de l'Association pour le développement de l'archéologie en Languedoc-Roussillon, Lattes

Lebeaupin D, Séjalon P (2014) Conclusion. Lattara 22:321-329

Malone C, Stoddart S, Ceccarelli L et al. (2014) Beyond feasting: consumption and life style amongst the invisible Etruscans. In: Boyle K, Rabett RJ, Hunt CO (eds) Living in the landscape. (McDonald Institute Monographs) McDonald Institute, Cambridge, pp 257-266

Marinval P (1988) L'alimentation végétale en France du M ésolithique jusqu'à l'Âge du Fer. Editions du CNRS, Toulouse

Marinval P (1996-97) L'étude des carporestes, In: Verdin F (ed) Coudounèu (Lançon-de-Provence, Bouches-du-Rhône): une ferme-grenier et son terroir au 5e siècle avant J.-C. (Documents d'Archéologie Méridionale 19-20) Association pour le Développement de l'Archéologie en Languedoc, Lattes, pp 165-198

Mercuri AM, Allevato E, Arobba D et al. (2015) Pollen and macroremains from Holocene archaeological sites: A dataset for the understanding of the bio-cultural diversity of the Italian landscape. Rev Palaeobot Palynol 218:250-266

Meyer W, Lebeaupin D, Séjalon P (2014) Les niveaux d'occupation et d'incendie à l'extérieur du bâtiment. Lattara 22:47-54

McGovern P, Luley BP, Rovira N, Mirzoian A, Callahan MP, Smith KE, Hall GR, Davidson T, Henkin JM (2013) Beginning of viniculture in France. PNAS 110:10,147-10,152

McGovern P, Luley BP, Hall G, Mirzoian A, Davidson T, Henkin J (2014) Les résidus vinaires trouvés dans les amphores étrusques de la zone 27. Lattara 22:289-294

McKenna WJB (1992) The environmental evidence. In: Evans DH, Tomlinson DG (eds) Excavations at 33-5 Eastgate, Beverley, 1983-86. (Sheffield Excavation Reports 3) Humberside Archaeology Unit, Sheffield, pp 227-233

Newman C, Silveréano S (2010), Lattes–Mas de Causse, Hérault, région Languedoc-Roussillon. Vol. II: études specialises. Oxford Archéologie Méditerranée. Unpublished technical report submitted to the Regional Archaeological Service

Perkins P, Attolini I (1992) An Etruscan farm at Podere Tartuchino. Papers of the British School at Rome 60:71-134

Puertas O (1998) Palynologie dans le delta du Lez. Contribution à l'histoire du paysage de Lattes. (Lattara 11) L'Association pour la recherche archéologique en Languedoc orientale, Lattes

Py M (1997) SYSLAT 3.1, Système d'Information Archéologique, Manuel de reference. Lattara 10

Py M (2009) Lattara, comptoir gaulois méditerranéen entre Etrusques, Grecs et Romains. Errance, Paris

Py M, Buxó R (2001) La viticulture en Gaule à l'âge du Fer. In: Brun JP, Laubenheimer F (eds) La viticulture en Gaule. (Gallia 58) CNRS editions, Paris, pp 29-43

Rovira N (2010) Les restes carpologiques d'époque protohistorique et romaine de Mas de Causse (Lattes, Hérault). In: Newman C, Silveréano S (eds) Lattes–Mas de Causse, Hérault, région Languedoc-Roussillon. Vol. II: études specialises. Oxford Archéologie Méditerranée. Unpublished technical repport

Rovira N, Alonso N (2010) Thanatocoenoses of seed and fruits from Zone 1 at Lattara (Lattes, France) during the 5th-4th centuries BC: the preliminary results. In: Bakels C, Fennema K, Out WA, Vermeeren C (eds) Of plants and snails. A collection of papers presented to Wim Kuijper. Sidestone Press, Leiden, pp 217-226

Ruas MP, Marinval P (1991) Alimentation végétale et agriculture d'après les semences archéologiques (de 9000 av. J.-C. au XVe siècle. In: Guilaine J (ed) Pour une Archéologie Agraire. À la croisée des sciences de l'homme et de la nature. Armand Colin, Paris, pp 409-439

Vandorpe P, Jacomet S (2011) Remains of burnt vegetable offerings in the temple area of Roman Oedenburg (Biesheim-Kuenheim, Haut-Rhin, Alsace): first results. In: Wiethold J (ed) Carpologia. Bibracte, Glux-en-Glenne, pp 87-100

Wiethold J (2009) Entrains-sur-Nohain (Nièvre) "8, rue de la voie romaine". Les macro-restes végétaux provenant d'un îlot d'Intaranum (Ier-IIIe s. ap. JC). Rapport d'étude carpologique 2009/27. Inrap Grand Est Nord, Metz, France

Wollstonecroft MM, Ellis PR, Hillman GC, Fuller DQ (2008) Advances in plant food processing in the Near Eastern Epipalaeolithic and implications for improved edibility and nutrient bioaccessibility: an experimental assessment of *Bolboschoenus maritimus* (L.) Palla (sea club-rush). Veget Hist Archaeobot 17:19-27

Zehnacker H (translator) (1999). Pline l'Ancien. Histoire naturelle. Collection Folio classique, éditions Gallimard, Paris

Figure captions

Fig. 1 Location of Lattara and reconstruction of the coastline and the lagoons of eastern Languedoc, France, during the Iron Age and Roman period (Jorda et al. 2008). Positions of other Iron Age sites in the area and the Etruscan quarter, in a photo on the bottom

Fig. 2 Distribution and importance of key taxa or groups of plants identified in the three houses and the southern alley according to the density of remains/l (27I2 phase). The pie charts numbered with stratigraphic units (SU) correspond to concentrations. The graphs without numbers correspond to the addition of the other stratigraphic units explored in each sector

Fig. 3 **1**, *Hordeum vulgare*, caryopses [SU 28112]; **2**, *Hordeum vulgare*, caryopses with glumes [SU 28166]; **3**, Six-row *Hordeum vulgare*, detail of a modern spikelet base (left) and an archaeological one (right) [SU 27674]; **4**, *Triticum aestivum/durum*, caryopses [SU 28117]; **5**, *Triticum dicoccum*, caryopsis [SU 28139] and spikelet fork [SU 28090]; **6**, *Vicia faba*, seed [SU 27665]; **7**, *Lathyrus sativus*, seed [SU 27491]; **8**, *Olea europaea*, stone [SU 28112]; **9** *Vitis vinifera*, pips [SU 28146]; **10**, *Prunus dulcis*, fruitstone fragment [SU 27665]; **11**, *Allium sativum*, garlic cloves [SU 27541]; photographs by SRI University of Lleida

Fig. 4 Distribution and importance of key taxa or groups of plants within the grid established to sample the southern alley (phase 27I2)

Fig. 5 **1**, **2**, *Juncus* sp., cluster of capsules [SU 27665]; **3**, *Juncus* sp., capsules [SU 27665]; **4**, *Avena fatua* [SU 28112], caryopsis (left) and glume base (right); **5**, *Bromus* cf. *arvensis*, caryopsis [SU 27665]; **6**, *Bromus* cf. *sterilis*, caryopsis [SU 27674]; **7**, *Bromus secalinus*, caryopsis [SU 27665]; **8**, *Galium aparine*, fruit [SU 27665]; **9**, *Sisymbrium* sp., seed [SU 27665]; **10**, *Anthemis cotula*, achene [SU 27674]; **11**, *Malva sylvestris*, seed (left) and fruit (right) [SU 27674]; **12**, *Bolboschoenus maritimus*, achene [SU 27589]; **13**, *Lolium temulentum*, caryopsis [SU 27665]; **14**, *Lolium perenne/rigidum*, caryopses [SU 27491]. Photographs by SRI, University of Lleida

Fig. 6 Histogram of the Index of Relative Abundance (IRA) per taxon for the phase 27I2

Fig. 7 Classification of plant groups and importance of wild plants (spring weeds and ruderals) identified in the cereal concentrations. **a**, Histogram according to the Index of Relative Abundance; **b**, stacked column chart according to the number of taxa by group

Table 1 Cultivated plants at Lattara, occurrence by century. The phase corresponding to the Etruscan houses is highlighted

ESM Tables

ESM Table 1 Overview of the stratigraphic units (SU) from the fire destruction level (phase 27I2) containing archaeobotanical remains

ESM Table 2 Overview of the stratigraphic units (SU) of the abandonment level (phase 27I1) containing archaeobotanical remains

ESM Table 3 Fire destruction level (phase 27I2): taxa identified in House 2713

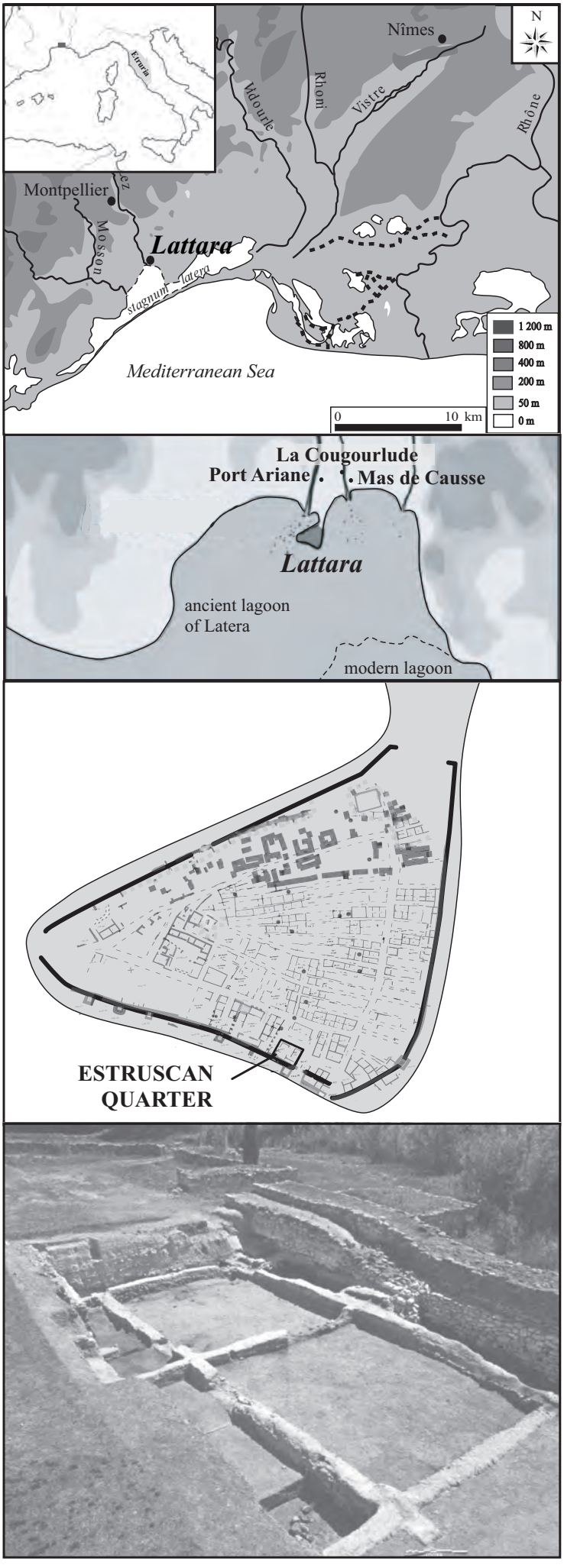
ESM Table 4 Abandonment level (phase 27I1): taxa identified in Houses 2713 and 2715

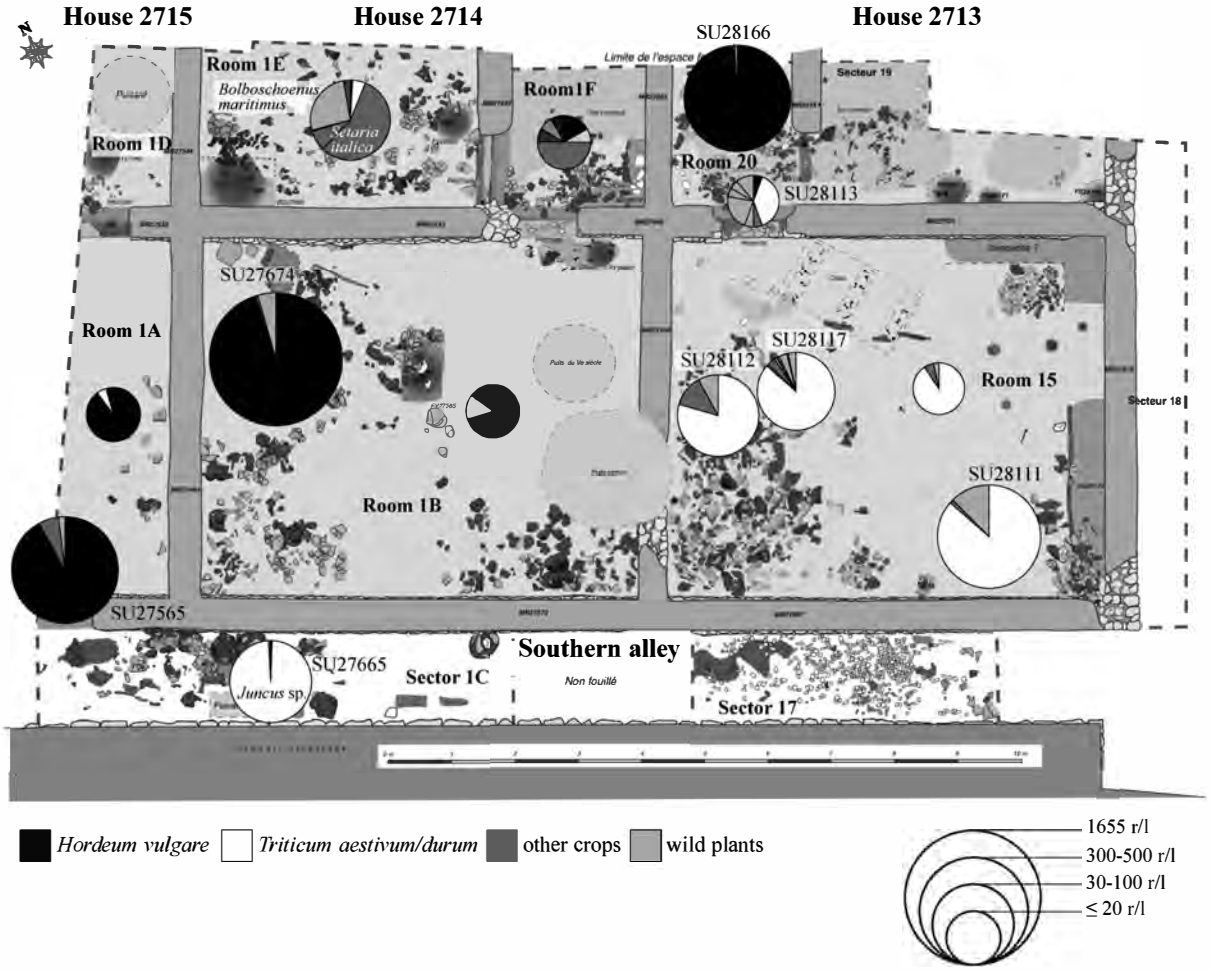
ESM Table 5 Fire destruction level (phase 27I2): taxa identified in House 2714

ESM Table 6 Fire destruction level (phase 27I2): taxa identified in House 2715

ESM Table 7 Fire destruction level (phase 27I2): taxa identified in the southern alley

Figure 1


Etruria
Nîmes
N
Mdourle
Rhoni
Vistre
Rhône
Montpellier
Mosson
Lattara
stagnum Latera
Mediterranean Sea
1 200 m
800 m
400 m
200 m
50 m
0 m
0
10 km
La Cougourlude
Port Ariane
Mas de Causse
Lattara
ancient lagoon
of Latera
modern lagoon
ESTRUSCAN
QUARTER


House 2715
House 2714
House 2713
Room 1E
Bolboschoenus maritimus
Setaria italica
Room1F
SU28166
Limite de l'espace fouillé
Secteur 19
Room 1D
Room 20
SU28113
SU27674
Room 1A
SU28117
SU28112
Room 15
Secteur 18
Room 1B
SU28111
SU27565
Southern alley
Non fouillé
SU27665
Juncus sp.
Sector 1C
Sector 17
Hordeum vulgare
Triticum aestivum/durum
other crops
wild plants
1655 r/l
300-500 r/l
30-100 r/l
≤ 20 r/l

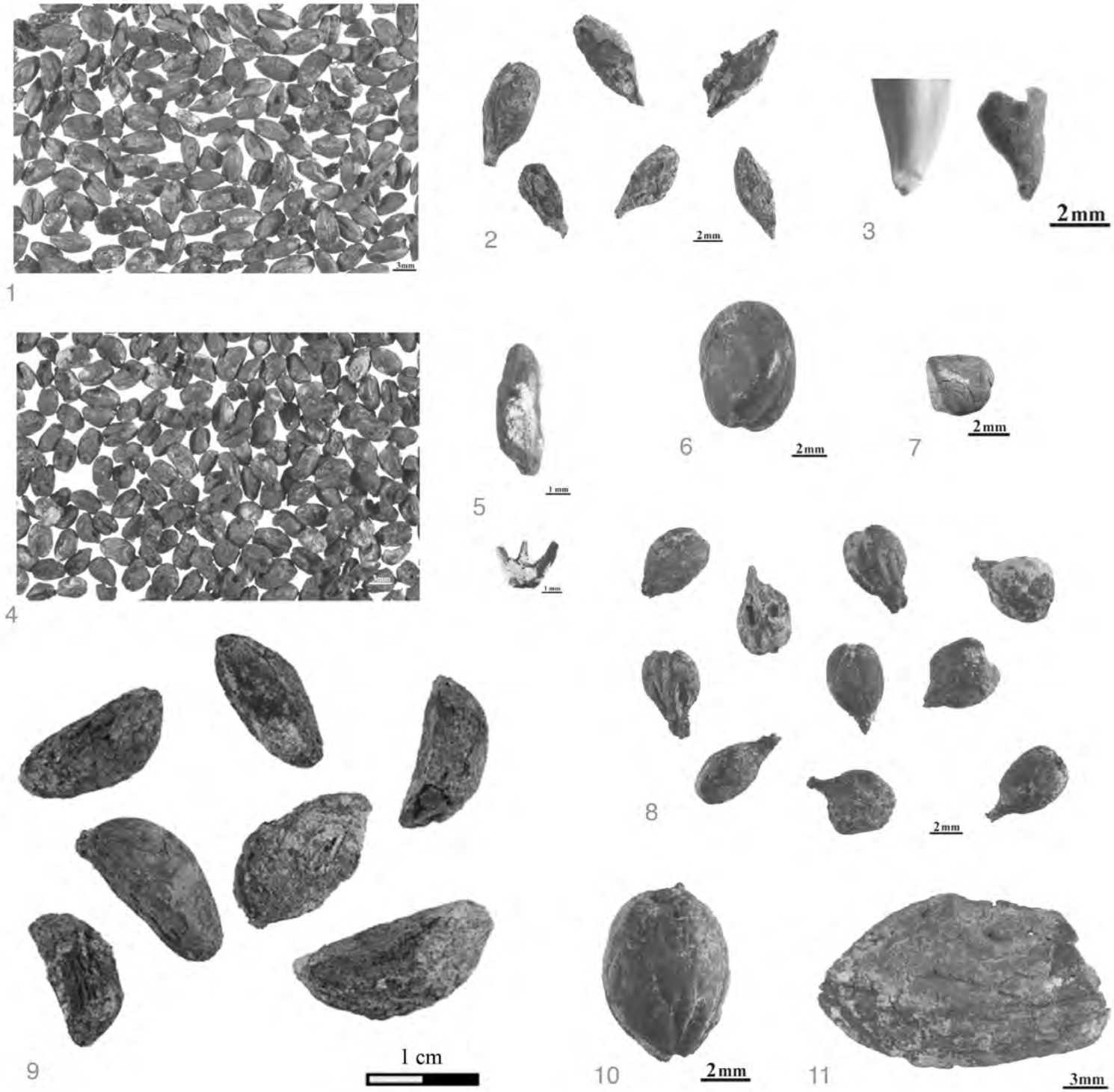


Figure 3

Figura 4


House 2715
House 2714
10
9
8
7
6
5
4
3
2
1
Southern alley
0
1 m
Juncus
Crops
Wild plants

Figura 5

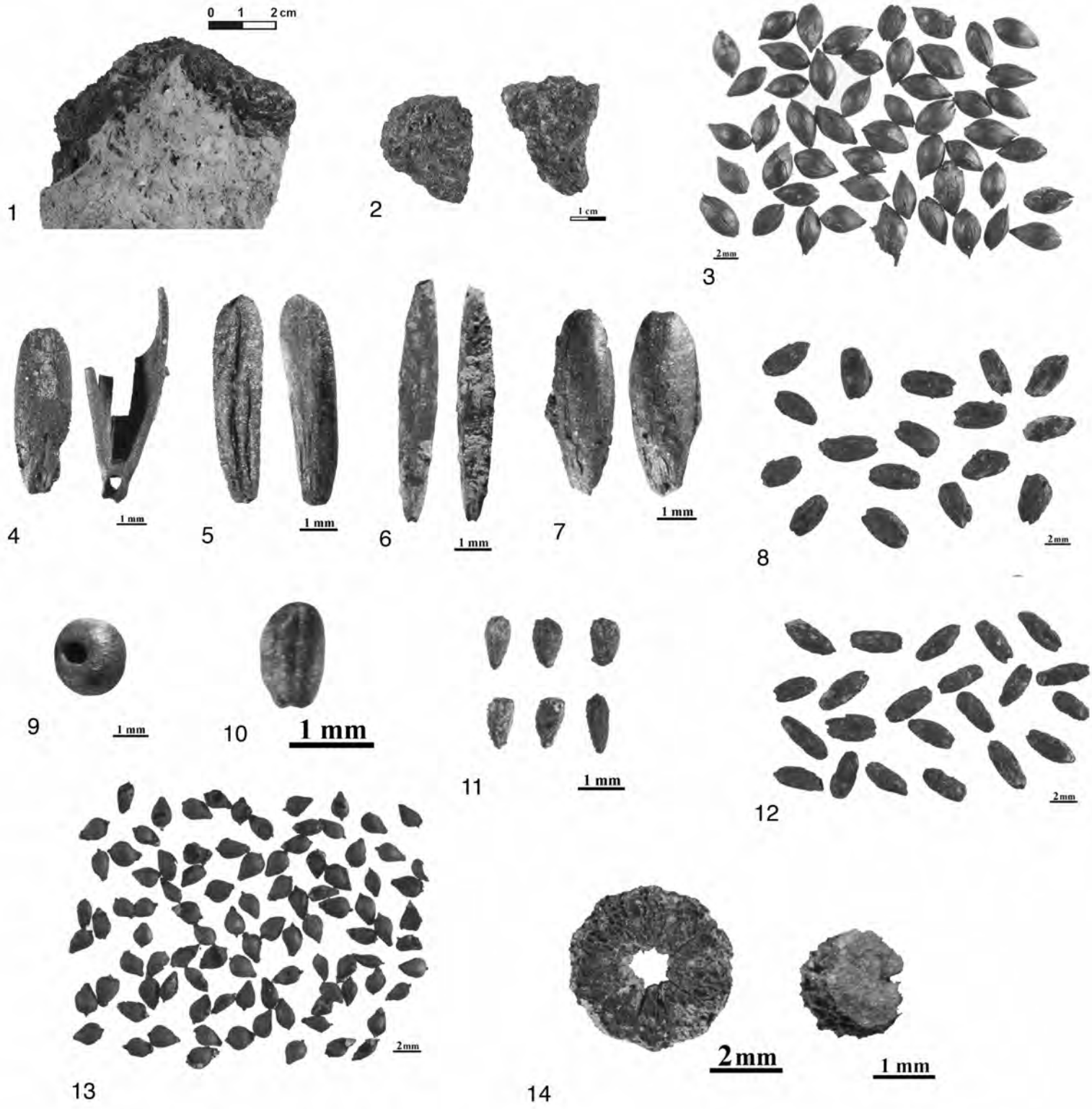
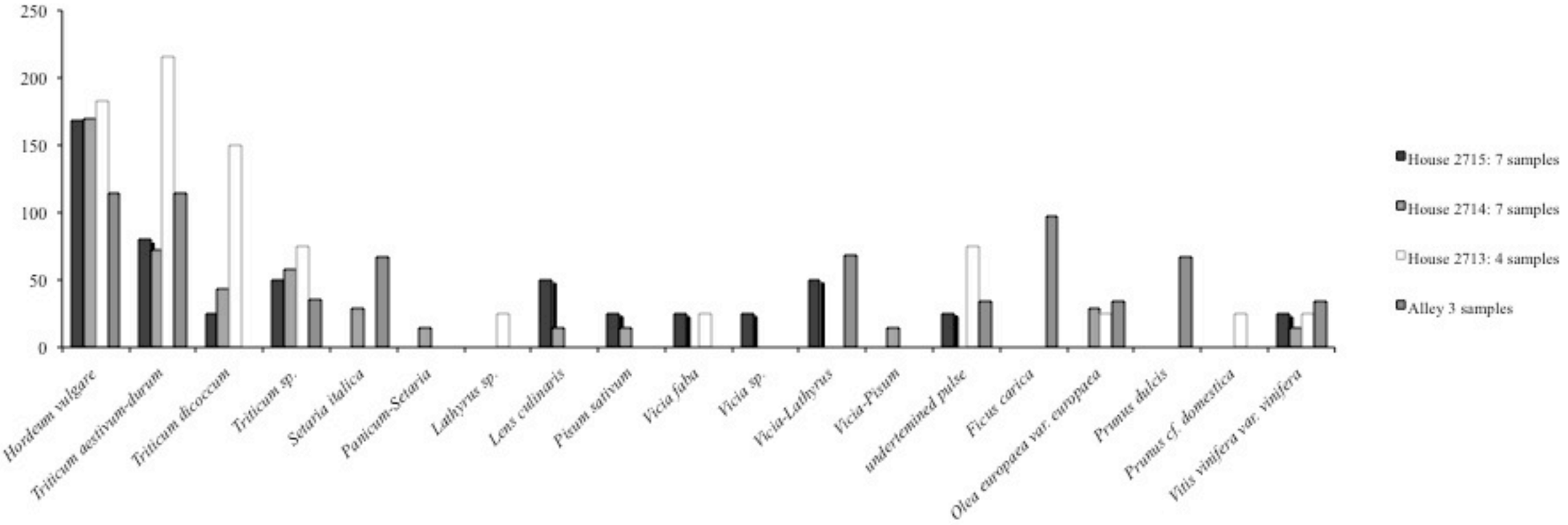
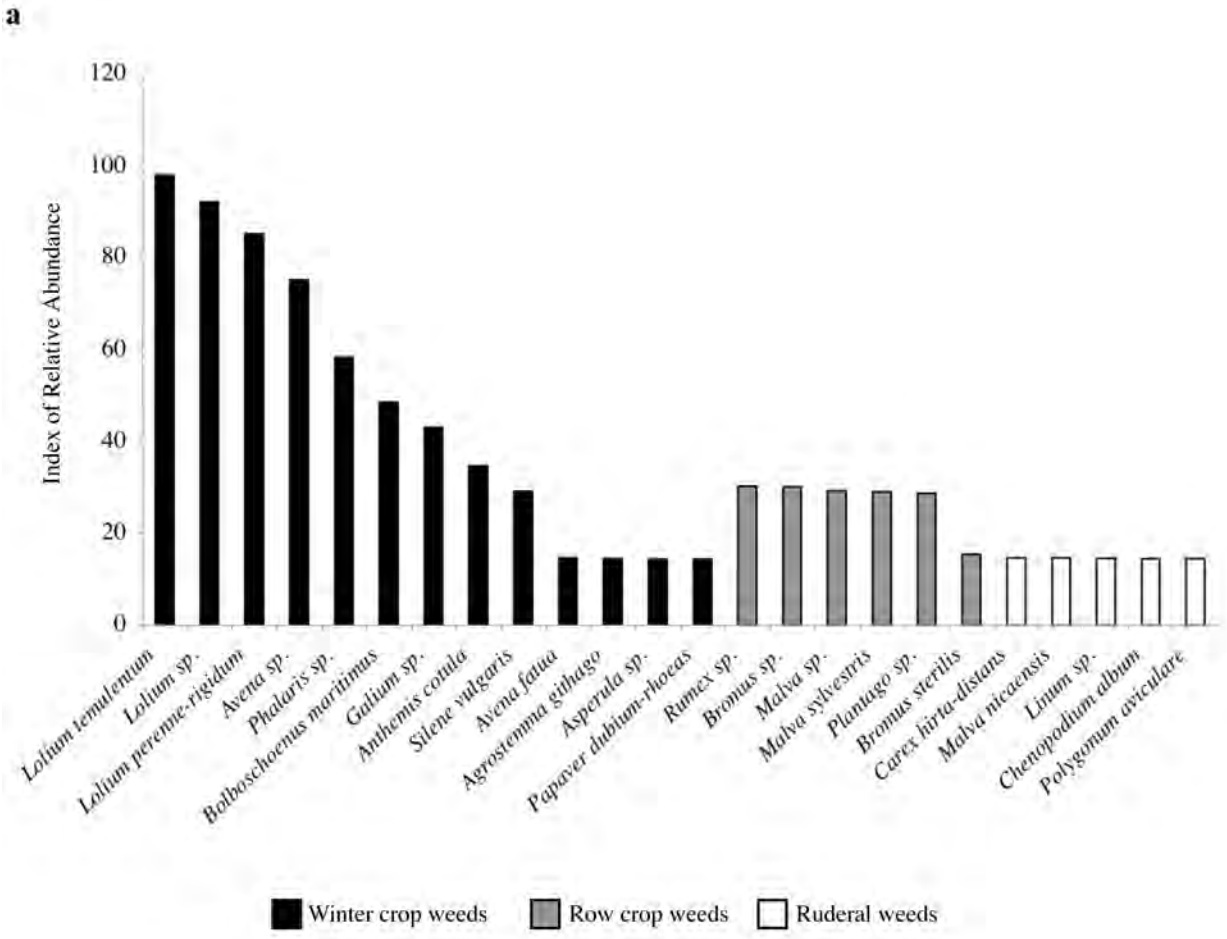
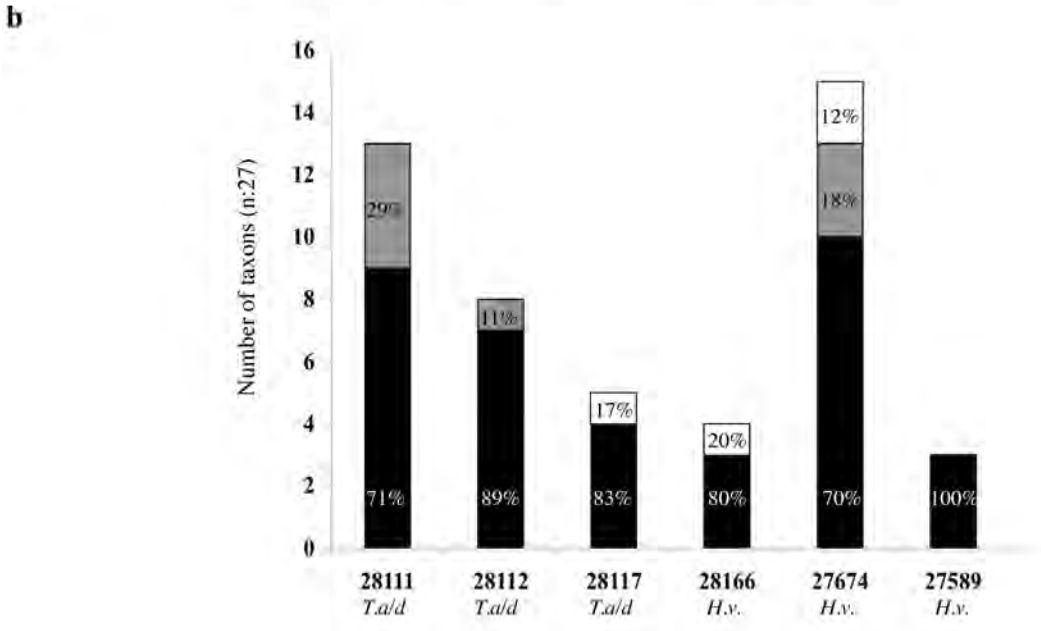

0 1 2 cm
1
2
1 cm
2mm
3
1 mm
4
1 mm
5
1 mm
6
1 mm
7
2mm
8
1 mm
9
1 mm
10
1 mm
11
2mm
12
2mm
13
2mm
1 mm
14

Figure 6


250
200
150
100
50
0
Hordeum vulgare
Triticum aestivum-durum
Triticum dicoccum
Triticum sp.
Setaria italica
Panicum-Setaria
Lathyrus sp.
Lens culinaris
Pisum sativum
Vicia faba
Vicia sp.
Vicia-Lathyrus
Vicia-Pisum
undetermined pulse
Ficus carica
Olea europaea var. europaea
Prunus dulcis
Prunus cf. domestica
Vitis vinifera var. vinifera
House 2715: 7 samples
House 2714: 7 samples
House 2713: 4 samples
Alley 3 samples


a
Index of Relative Abundance
120
100
80
60
40
20
0
Lolium temulentum
Lolium sp.
Lolium perenne-rigidum
Avena sp.
Phalaris sp.
Bolboschoenus maritimus
Galium sp.
Anthemis cotula
Silene vulgaris
Avena fatua
Agrostemma githago
Asperula sp.
Papaver dubium-rhoeas
Rumex sp.
Bromus sp.
Malva sp.
Malva sylvestris
Plantago sp.
Bromus sterilis
Carex hirta-distans
Malva nicaensis
Linum sp.
Chenopodium album
Polygonum aviculare
Winter crop weeds
Row crop weeds
Ruderal weeds


b
Number of taxons (n:27)
16
14
12
10
8
6
4
2
0
29%
71%
11%
89%
17%
83%
20%
80%
12%
18%
70%
100%
28111
T.a/d
28112
T.a/d
28117
T.a/d
28166
H.v.
27674
H.v.
27589
H.v.

						BC	AD
	Etruscan	5th	4th	3rd	2nd	1st	1st
Cereals							
Hordeum vulgare	•	•	•	•	•	•	•
Triticum aestivum/durum	•	•	•	•	•	•	•
Triticum aestivum/durum compactum type		•	•	•	•	•	
Triticum dicoccum	•	•	•	•		•	•
Triticum monococcum		•	•	•	•		
Panicum miliaceum	•	•	•	•			
Setaria italica	•	•	•				
Avena sp		•	•	•	•		
Pulses							
Cicer arietinum			•				
Lathyrus cicera			•	•			
Lathyrus sativus	•	•	•				•
Lens culinaris	•	•	•	•	•		•
Medicago cf.*sativa*			•				
Pisum sativum	•	•	•	•			•
Vicia faba var. *minor*	•	•	•	•			•
Vicia ervilia		•	•	•			
Vicia sativa			•				
Condiments/medicinale							
Allium sativum	•						
Oil plants							
Linum usitatissimum	•	•	•				
Fruits							
Celtis sp.							•
Coriandrum sativum			•				
Ficus carica	•	•	•				
Juglans regia							•
Olea europaea var. *europaea*	•	•	•	•			•
Prunus domestica	•						•
Prunus dulcis	•						
Prunus persica							•
Vitis vinifera	•	•	•	•	•	•	•

ESM Table 1 Overview of the stratigraphic units (SU) from the fire destruction level (phase 27I2) containing archaeobotanical remains

Fire destruction level (Phase 27I2)				
House	**Room**	**SU**	**Description/Interpretation**	**Sample type**
2713	15	28094	Fire layer on the surface of the SU 28095	dispersed
		28095	Sample from the base of an amphora	grouped
		28111	Accidental deposit of charred seeds in the south-eastern part of the room, resulting from the fire, and associated with in situ crushed amphorae and bowl/lids. Cluster: 40 x 25cm. E1-F1	grouped
		28112	Accidental deposit of charred seeds in the western part of the room, resulting from the fire. Sample associated with in situ, crushed amphorae, in particular the bottom of the amphora VP28118. Cluster corresponding to one m^2. C7-D7	grouped
		28117	Accidental deposit of charred grains in the western part of the room, resulting from the fire. Cluster spread over a diameter of 20-25 cm	grouped
	20	28113	Layer of ash covering level 28104 and the threshold of the door PR28105	grouped
		28166	Accidental deposit of charred grains in the western part of the room, resulting from the fire, together with the base of a fragmented amphora. Cluster spread over a diameter of 45 cm	total
2714	1B	27422	Destruction layer of an earth-built feature	total
		27674	Accidental deposit of charred seeds in the north-eastern part of the room, resulting from the fire. Cluster diameter 20-25 cm	total
		27675	Floor level of sand. Surface with many fragments of Etruscan amphorae and *bucchero nero* vessels; pile of charred grains and fragments of wood	dispersed
		28075	Ash and charcoal layer	total
	1E	27589	It is not determined if its origin is human or fluvial	dispersed
		28074	Concentration of charcoal and ash on the floor of the room	isolated
	1F	28076	Ash and charcoal layer	isolated
2715	1A	27423	Destruction layer of an earth-built feature	total
		27565	Destruction layer of a carbonised feature, small pocket of grains and charcoal	isolated
		27676	Destruction layer on a carbonised board that was part of the threshold of the door PR27600	grouped
	1D	27541	Sand layer	isolated (by hand)
Southern alley	1C	27665	Artefacts on the circulation layer in the western part of the alley	clustered/ total by m^2
		28107	Artefacts on the circulation layer in the western part of the alley	grouped
	17	28146	Artefacts on the circulation layer in the eastern part of the alley	grouped

ESM Table 2 Overview of the stratigraphic units (SU) of the abandonment level (phase 27I1) containing archaeobotanical remains

Level of abandonment (Phase 27I1)				
House	**Room**	**SU**	**Description/ Interpretation**	**Sample type**
2713	15	28090	Backfill stemming from the destruction of mud brick walls	dispersed
	20	28138	Layer of destruction of a mud brick feature	dispersed
		28143	Heterogeneous layer of destruction	dispersed
	18	28139	Layer of destruction of a mud brick feature	dispersed
		28150	Heterogeneous layer of destruction	dispersed
2715	3	27491	Accidental deposit of charred grains and fibrous elements between two collapsed mud brick walls	grouped
	1A	27560	Pocket containing fish scales in the backfill of a house	isolated

ESM Table 3

		House 2713															
Room		15										20					
SU		28094		28095		28111		28112		28117		28113		28166			
sample liters		100		4		29,5		38		15		8		10		**Total NR**	**Ubiquity (7 samples)**
		ind	frag	ind	frag	ind	frag	ind	frag	ind	frag	ind	frag	ind	frag		
Cereals																	
Hordeum vulgare	seed	3				42		285	30	5	1	1		3550	1042	4959	6
	glume													12		12	1
Triticum aestivum/durum	seed	226	20			4909	3425	2025	136	490		7		1		11239	6
Triticum dicoccum	seed	9		1				20	3	18	3	1		4		59	6
	base glume	1				4										5	2
	spikelet base					11		1								12	2
Triticum sp.	seed					12		11	554		57					634	3
	base glume							2		1						3	2
	spikelet base							1								1	1
	rachis node	1						1								2	2
Hordeum/Triticum	seed		166						120		180		2			468	4
	base glume					14		1								15	2
	base épillet					1										1	1
	segment rachis									2						2	1
Pulses																	
Lathyrus sp.	seed													2		2	1
Vicia faba	seed		1													1	1
undetermined pulses	seed							1								1	1
Fruits																	
Olea europaea var. *europaea*	seed		5					1	7						1	14	3
Prunus cf. *domestica*	seed		1													1	1
Vitis vinifera var. *vinifera*	seed								1							1	1
Winter cereal weeds																	
Agrostemma githago	seed					2										2	1
Anthemis cotula	seed					2										2	1
Asperula sp.	seed									1						1	1
Asteraceae	seed													1		1	1
Avena fatua	awn							1								1	1
Avena sp.	awn					5										5	1
	seed					16		2						5		23	3
Bolboschoenus maritimus	seed	1			1	2		1	1				41			47	5
Caryophilliaceae	seed					2										2	1
Galium sp.	seed							2		1						3	2
Lolium temulentum	seed	3				76		123		18		4		2		226	6
Lolium perenne/rigidum	seed					548		12						12		572	3
Lolium sp.	seed						14	21		3	2			4		44	4
Phalaris sp.	seed			1		18		3		1		1				24	5
Poaceae	seed	2	5			6	9	32	18	18	8	2	20	1		121	6
Rubiaceae	seed								1							1	1
Silene sp.	seed					1		2								3	2
Silene vulgaris	seed					6										6	1
Row crop weeds																	
Bromus sp.	seed			1				1								2	2
Malva sp.	seed					13		2								15	2
Malva sylvestris	seed					1										1	1
Medicago sp.	seed											1				1	1
Plantago sp.	seed													1		1	1
Ruderal weeds																	
Chenopodiaceae	seed					1										1	1
Cyperaceae	seed		13							6						19	2
Labiatae	seed					2										2	1
cf. *Linum* sp.	seed									5						5	1
Polygonum aviculare	seed					2										2	1
Rumex sp.	seed	1				2										3	2
Wetlands																	
Juncus sp.	capsule			4												4	1
Total		246	211	7	1	5687	3448	2549	870	569	251	17	63	3595	1043	18557	
Total NR		**457**		**8**		**9135**		**3419**		**820**		**80**		**4638**			
density per litre		4,57		2		309,7		90,0		54,7		10		463,8			

ESM Table 4

		House 2713										House 2715					
Room		**15**		**16**				**18**				**3**		**1a**			
SU		**28090**		**28138**		**28143**		**28139**		**28150**		**27491**		**27560**			
Sample litres		20		20		100		20		20		3		6		**Total NR**	**Ubiquity (7 samples)**
		ind	frag	ind	frag	ind	frag	ind	frag	ind	frag	ind	frag	ind	frag		
Cereals																	
Hordeum vulgare	seed			5	3	10	5	4		2	7			2		38	5
Triticum aestivum/durum	seed							4				1		2		7	3
Triticum dicoccum	glume base							1								1	1
	spikelet base	1						2								3	2
	seed							5				43	4		1	53	3
Triticum sp.	glume base		1													1	1
	seed		1	4				1	1	1			6	1	1	16	6
	rachis node							2								2	1
Hordeum/Triticum	seed		5		4		8		29						4	50	5
	glume base									2						2	1
	rachis node									1						1	1
Panicum miliaceum	seed				1											1	1
Cerealia	stem frag.							1								1	1
Pulses																	
Lathyrus sativus	seed											1				1	1
undetermined pulses	seed						1									1	1
Oil and fibre plants																	
Linum usitatissimum	seed									1						1	1
Fruit																	
Vitis vinifera var. *vinifera*	seed							1								1	1
Winter cereal weeds																	
Apiaceae	seed			1												1	1
Lolium sp.	seed					6							2			8	2
Poaceae	seed		3								2		6	1		12	4
Spring weeds																	
Malva sp.	seed			1												1	1
Ruderals																	
Cyperaceae	seed				6											6	1
Cistus sp.	seed	1														1	1
	Total	2	10	11	14	16	14	21	30	7	9	45	18	6	6	**209**	
	Total NR	**12**		**25**		**30**		**51**		**16**		**63**		**12**			
	Density per litre	0,6		1,25		0,3		2,55		0,8		21		2			

ESM Table 5

		House 2714															
Room		**1B**								**1E**				**1F**			
SU		**27422**		**27674**		**27675**		**28075**		**27589**		**28074**		**28076**			
Sample litres		20		40		20		50		20		8		12		**Total NR**	**Ubiquity (7 samples)**
		ind	frag	ind	frag	ind	frag	ind	frag	ind	frag	ind	frag	ind	frag		
Cereals																	
Hordeum vulgare	seed			41029	22504	18		1				5		2		63559	5
	glume			86												86	1
	rachis segment			9												9	1
Triticum aestivum/durum	seed	1		168		3	1			7		17				197	5
Triticum dicoccum	seed	1		8				1								10	3
Triticum sp.	seed	1		40									8	1		50	4
	glume base			3						1						4	2
	spikelet base			97												97	1
Hordeum/Triticum	seed								4		7		92			103	2
	glume			27												27	1
	rachis node									2		1				3	2
	rachis segment			1												1	1
Setaria italica	seed									144		120				264	2
Panicum/Setaria	seed									39						39	1
Cerealia	glume base			16												16	1
	glume				86											86	1
	rachis segment			11												11	1
Pulses																	
Lens culinaris	seed			1												1	1
Pisum sativum	seed			1												1	1
Vicia/Pisum	seed			8												8	1
Fruit																	
Olea europaea var. *europaea*	seed					1					1					2	2
Vitis vinifera var. *vinifera*	seed													6	3	9	1
(mineralised)	seed											1				1	1
Winter cereal weeds																	
Anthemis cotula	seed			133												133	1
Apiaceae	seed			2												2	1
Asteraceae	seed			1												1	1
Avena fatua	glume			8												8	1
	seed			8												8	1
Avena sp.	awn			1												1	1
	glume			48												48	1
	seed			376												376	1
Bolboschoenus maritimus	seed									121	300	6	2			429	2
Bromus sterilis	seed			24												24	1
Galium sp.	seed									2						2	1
Lolium temulentum	seed			368												368	1
Lolium perenne/rigidum	seed			47												47	1
Lolium sp.	seed			106	180					2						288	2
Papaver dubium/rhoeas	seed			1												1	1
Phalaris sp.	seed			4												4	1
Poaceae	awn			1												1	1
	glume			9												9	1
	seed			680	37							3	9		3	732	3
Silene sp.	seed			32												32	1
Silene vulgaris	seed			5												5	1
Spring weeds																	
Brassicaceae	seed													1		1	1
Bromus sp.	seed			32	8											40	1
Malva sylvestris	seed			9												9	1
Medicago sp.	seed									1						1	1
Plantago sp.	seed			1												1	1
Rumex sp.	seed			33												33	1
Setaria sp.	seed											1				1	1
Ruderals																	
Carex hirta/distans	seed			8												8	1
Chenopodiaceae	seed			1								1				2	2
Chenopodium album	seed			2												2	1
Cyperaceae	seed														6	6	1
Malva nicaeensis	fruit			8												8	1
Malvaceae	seed			2												2	1
Rosmarinus officinalis	leaf			1	3											4	1
Total		3	0	43385	22815	22	1	2	4	319	308	154	111	10	12	**67146**	
Total NR		**3**		**66200**		**23**		**6**		**627**		**265**		**22**			
Density per litre		0,2		1655		1,2		0,1		31,4		33,1		1,8			

ESM Table 6

		House 2715									
Room		**1a**						**1d**			
SU		**27423**		**27565**		**27676**		**27541**			
Sample litres		39		7		5		-		**Total NR**	**Ubiquity (4 samples)**
		ind	frag	ind	frag	ind	frag	ind	frag		
Cereals											
Hordeum vulgare	seed	383	149	1316	896			1		2745	3
Triticum aestivum/durum	seed	25	5	60		1	1			92	3
Triticum dicoccum	seed	1								1	1
Triticum sp.	seed	1	5	5	8					19	2
Hordeum/Triticum	seed		197		687					884	2
Pulses											
Lens culinaris	seed	1		1						2	2
Pisum sativum	seed			5						5	1
Vicia faba	seed			2						2	1
Vicia sp.	seed			4						4	1
Vicia/Lathyrus	seed	2		3						5	2
undetermined pulses	seed			9	18					27	1
Fruit											
Vitis vinifera var. *vinifera*	seed			1						1	1
Condiments or medicinal											
Allium sativum	bulb							13	5	18	1
Winter cereal weeds											
Lolium sp.	seed	2		7						9	2
Poaceae	seed	8		14	6					28	2
	awn				2					2	1
Rubiaceae	seed	2		3						5	2
Spring weeds											
Bromus sp.	seed	1								1	1
	Total	424	356	1427	1615	1	1	14	5	**3843**	
	Total NR	**780**		**3042**		**2**		**19**			
	Density per litre	20		435		0,4		-			

ESM Table 7

		Southern alley							
	Sector	**17**		**1c**					
	SU	**28146**		**27665**		**28107**			
	Sample litres	100		118		7		**Total NR**	**Ubiquity (3 samples)**
		ind	frag	ind	frag	ind	frag		
Cereals									
Hordeum vulgare	seed	1		35	4			40	2
Triticum aestivum/durum	seed	1		35		2		38	3
Triticum sp.	seed			5	1		1	7	2
Hordeum/Triticum	seed		2		3			5	2
Setaria italica	seed			2				2	1
Pulses									
Vicia/Lathyrus	seed			3				3	1
undetermined pulses	seed			2				2	1
Fruit									
Ficus carica	seed	149						149	1
Olea europaea var. *europaea*	seed			1				1	1
Prunus dulcis	shell				1			1	1
Vitis vinifera var. *vinifera*	seed	21	1	2	3			27	2
Weeds of winter cereals									
Asperula sp.	seed					1		1	1
Asteraceae	seed			1				1	1
Avena fatua	awn			1				1	1
	glume			1				1	1
	seed			1				1	1
Avena sp.	seed			3				3	1
Bolboschoenus maritimus	seed	18		7	5	10		40	3
Bromus secalinus	seed			1				1	1
Caryophyllaceae	seed			1				1	1
Galium aparine	seed			4				4	1
Lolium temulentum	seed			2				2	1
Lolium sp.	seed	2		1				3	2
Phalaris sp.	seed			3				3	1
Poaceae	seed	4	6	14	6			30	2
Spring weeds									
Amaranthus sp.	seed			1				1	1
Atriplex sp.	seed			1				1	1
Brassicaceae	seed			2				2	1
Malva sp.	seed			1				1	1
Medicago sp.	seed			4				4	1
Melilotus sp.	seed			2				2	1
Ruderals									
Bromus arvensis	seed			1				1	1
Carex sp.	seed			5				5	1
Chenopodium sp.	seed	2						2	1
Cyperaceae	seed		4					4	1
Labiatae	seed			1				1	1
Sisymbrium sp.	seed			17				17	1
Wetlands									
Juncus sp.	seed			6857				6857	1
	capsule			3625	4			3629	1
	rhizome		2					2	1
	Total	198	15	10625	27	13	1	**10879**	
	Total NR	**213**		**10652**		**14**			
	Density per litre	2,13		90,3		2			